Claims

[c1] In an electric motor of the type comprising an internal stator, including a shaft fixedly mounted to a structural support and having multiple windings capable of reversible current flow to alter the winding polarity, and an external rotor rotatably mounted to the shaft and having multiple magnets radially spaced about the periphery of the stator, with each of the magnets having at least one predetermined pole; the improvement wherein:
the stator comprises a plurality of plates on the shaft under sufficient compression to inhibit bending of the shaft due to external forces that would otherwise tend to cause the windings to contact the magnets.

[c2] The electric motor according to claim 1, wherein the plurality of plates forms a winding core that carries the multiple windings.

[c3] The electric motor according to claim 2, wherein the plates form winding poles with caps on the end of each pole to retain the windings on the winding poles.

[c4] The electric motor according to claim 1, wherein the plates are held in compression by at least one lock nut.

[c5] The electric motor according to claim 1, wherein the windings are oriented on the core such that the winding longitudinal axis forms an acute angle relative to the shaft longitudinal axis.

[c6] The electric motor according to claim 5, wherein the acute angle is 10 degrees.

[c7] A method of forming a winding core for an electric motor of the type comprising an internal stator, including a shaft fixedly mounted to a structural support and having multiple windings capable of reversible current flow to alter the winding polarity, and an external rotor rotatably mounted to the shaft and having multiple magnets radially spaced about the periphery of the stator, with each of the magnets having at least one predetermined pole, comprising the steps of:
providing a shaft with a keyway oriented at an acute angle relative to the longitudinal axis of the shaft;
providing plates, each having radial poles with caps at the end of each pole and

a key corresponding in shape to the keyway;
placing a stop on the shaft;
sliding each plate on the shaft following the keyway with the first plate bearing against the stop until a plurality of plates are mounted to the shaft;
compressing the plates to form a lamination; and
securing a lock nut on the shaft adjacent to the last plate to hold the lamination in compression.

[c8] A method of forming a winding core for an electric motor of the type comprising an internal stator, including a shaft fixedly mounted to a structural support and having multiple windings capable of reversible current flow to alter the winding polarity, and an external rotor rotatably mounted to the shaft and having multiple magnets radially spaced about the periphery of the stator, with each of the magnets having at least one predetermined pole, comprising the steps of:
providing a hollow cylindrical jig having at least one keyway;
providing plates, each having a central opening, radial poles with caps at the end of each pole, and having a key corresponding in shape to the keyway;
placing a stop in the jig;
sliding each plate in the jig following the keyway with the first plate bearing against the stop until a plurality of plates are disposed in the jig;
pressing a shaft into the central openings
compressing the plates to form a lamination; and
securing a lock nut on the shaft adjacent to the last plate to hold the lamination in compression.

[c9] In an electric motor of the type comprising an internal stator, including a shaft fixedly mounted to a structural support and having multiple windings capable of reversible current flow to alter the winding polarity, and an external rotor rotatably mounted to the shaft and having multiple magnets radially spaced about the periphery of the stator, with each of the magnets having at least one predetermined pole; the improvement wherein:
the shaft is mounted to the structural support through at least one mounting block having a yoke with two opposing bushed pins and a clamp carrying the

shaft, mounted to the bushings whereby the mounting block damps vibrations of the motor in all directions while maintaining torsion stability.

[c10] The electric motor according to claim 9, wherein the shaft end is keyed and the clamp comprises upper and lower connection plates shaped to receive the keyed shaft end.

[c11] The electric motor according to claim 10, wherein each of the upper and lower connection plates has a recess complementary in shape to the bushing and sized to co act with each other to clamp the bushing between them.

[c12] The electric motor according to claim 11, wherein each recess is located eccentrically relative to a longitudinal axis of the connection plate.

[c13] In an electric motor of the type comprising an internal stator, including a shaft fixedly mounted to a structural support and having multiple windings capable of reversible current flow to alter the winding polarity, and an external rotor rotatably mounted to the shaft and having multiple magnets radially spaced about the periphery of the stator, with each of the magnets having at least one predetermined pole; the improvement comprising:
a sensor assembly capable of generating over 1000 pulse signals for each revolution of the rotor.

[c14] The electric motor according to claim 13, wherein the sensor assembly comprises an opto-reflective sensor.

[c15] The electric motor according to claim 14, wherein the opto-reflective sensor comprises a light source, a receptor, and a disk having over 1000 radial grooves positioned so that there is relative movement between the disk and the receptor corresponding to movement of the rotor relative to the stator.

[c16]

In an electric motor of the type comprising an internal stator, including a shaft fixedly mounted to a structural support and having multiple windings capable of reversible current flow to alter the winding polarity, and an external rotor rotatably mounted to the shaft and having multiple magnets radially spaced about the periphery of the stator, with each of the magnets having at least one

predetermined pole; the improvement wherein:

a first end of the shaft is mounted to the structural support and the second end of the shaft is not;

the rotor has an extension mounted at the end thereof nearer the second shaft end; and

a second shaft has one end secured to the structural support and a second end mounted rotatably to the extension, collinear with the shaft.